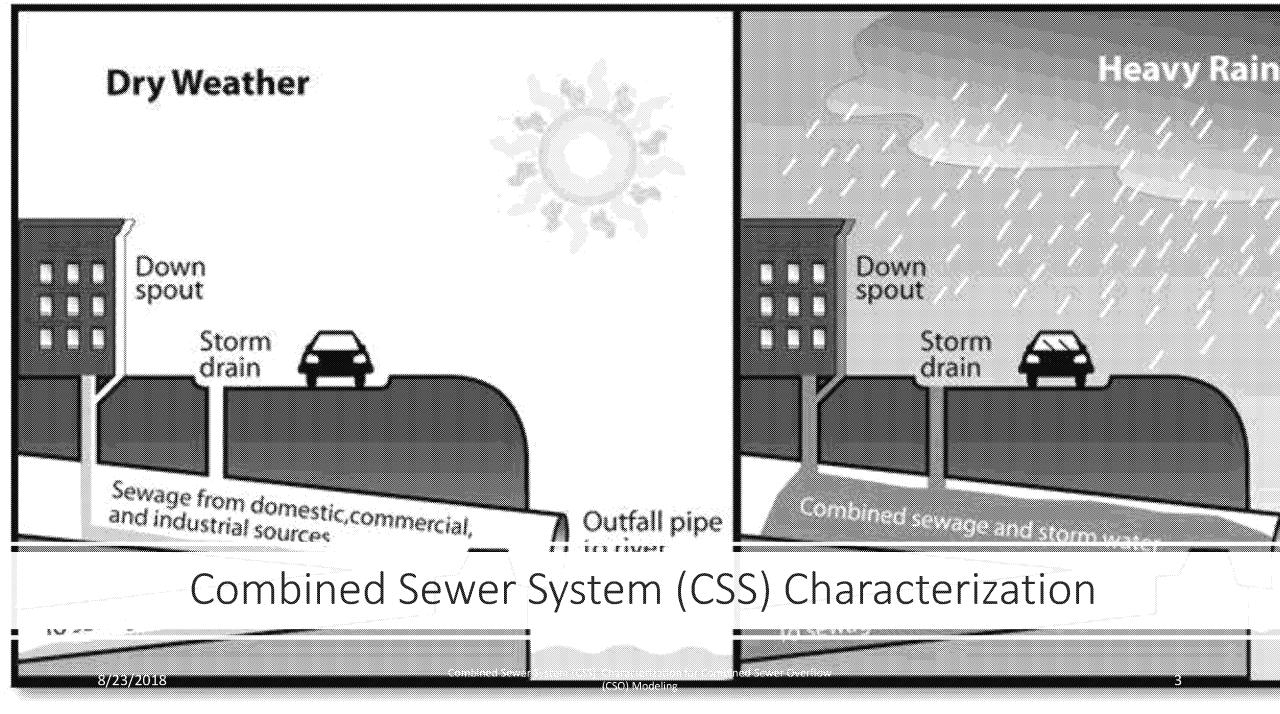


- Combined Sewer
 System(CSS)
 Characterization
- CSO Controls
 - ▶Gray Infrastructure
 - ➤ Green Infrastructure
- CSO Volume and/or Event
 - ➤Treated

8/23/2018

→Untreated

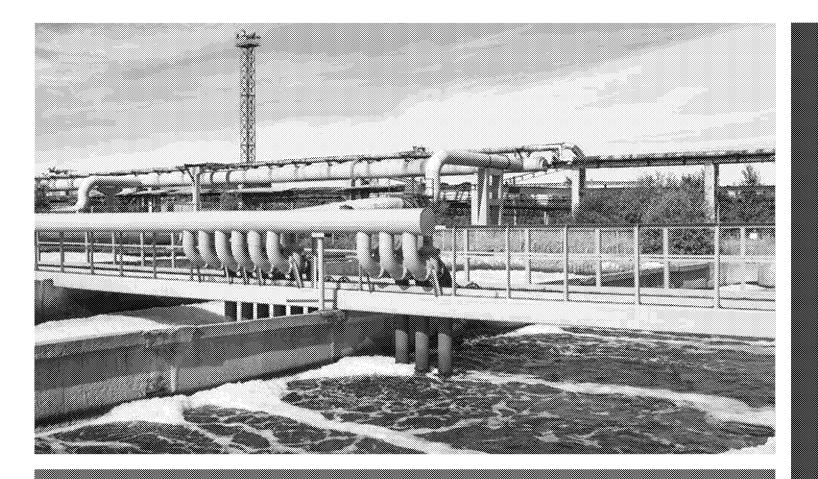


What Does Tom Look Like?



CSS Characterization

- What is CSS characterization?
 - ➤ How does the CSS react due to a participation event?
 - Not looking at the typical or design rainfall event, but any rainfall event

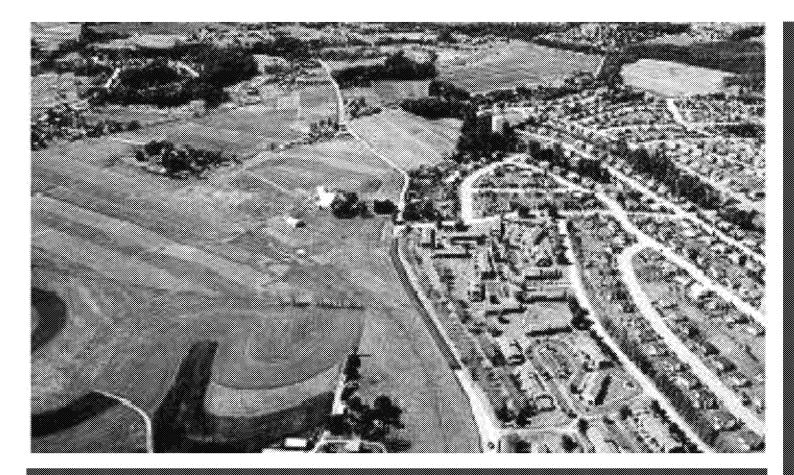


Three Components of System Characterization

- Physical characterization:
 - ➤ What are the components of the CSS?
 - pipes, pumps, hydraulic control structures, treatment facilities.
 - How does the CSS respond to rainfall?
- Characterization of combined sewage and CSO
 - Characterization of precipitation
 - ➤ What significant pollutants are present in CSO?
- Characterization of receiving waters
 - Are CSOs likely to cause WQ standards violations?





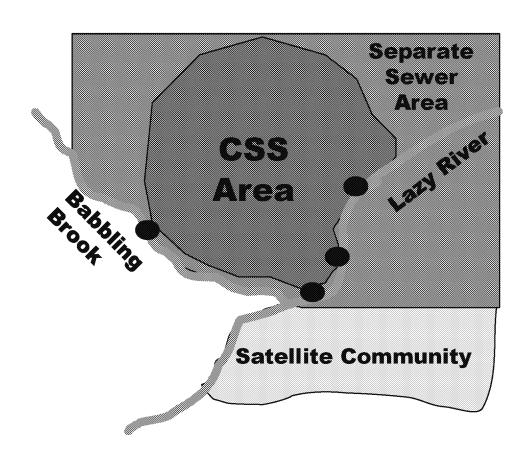


Physical Characterization cont.

- Typically includes:
 - Delineation of CSS area and sewersheds
 - ➤ Locating CSO outfalls, regulator structures, the WWTP, and pump stations
 - Estimating land use and impervious cover, by sewershed
 - Showing layout of major interceptors
 - ➤ Identifying hydraulic capacities for the WWTP, CSO regulators, and pump stations
 - ➢ Identifying CSO receiving waters
 - ➤ The written component of physica characterization in an LTCP usually includes a variety of maps and figures.

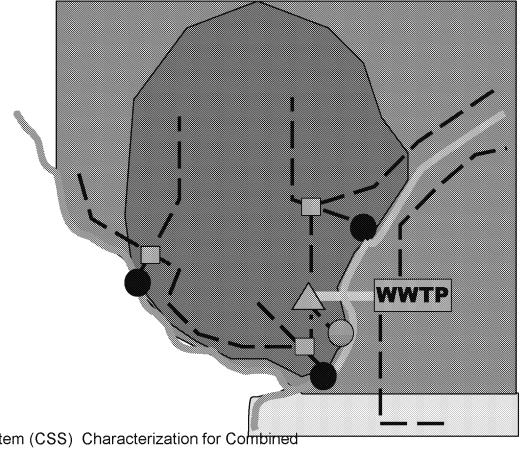
Physical Characterization of Springfield, USA

- Let's introduce Springfield, USA as our example community
- Springfield has a CSS with four outfalls that discharge to two separate receiving waters, Babbling Brook and Lazy River
- Springfield also has a separate sewer area and a satellite community



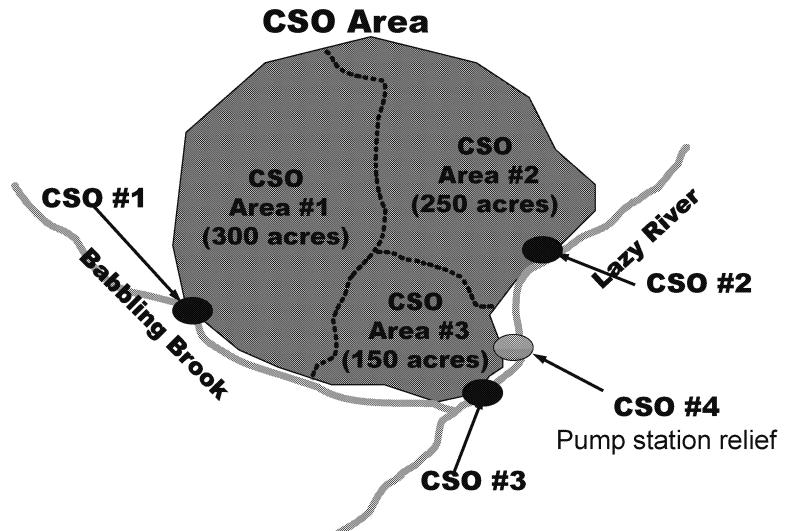
Overview of Collection System

- Layout of major interceptors
- Location of:
 - >WWTP \(\)
 - ➤ CSO Regulators
 - ➤ Pump Station
 - ➤ Outfall Locations



Combined Sewer System (CSS) Characterization for Combined Sewer Overflow (CSO) Modeling

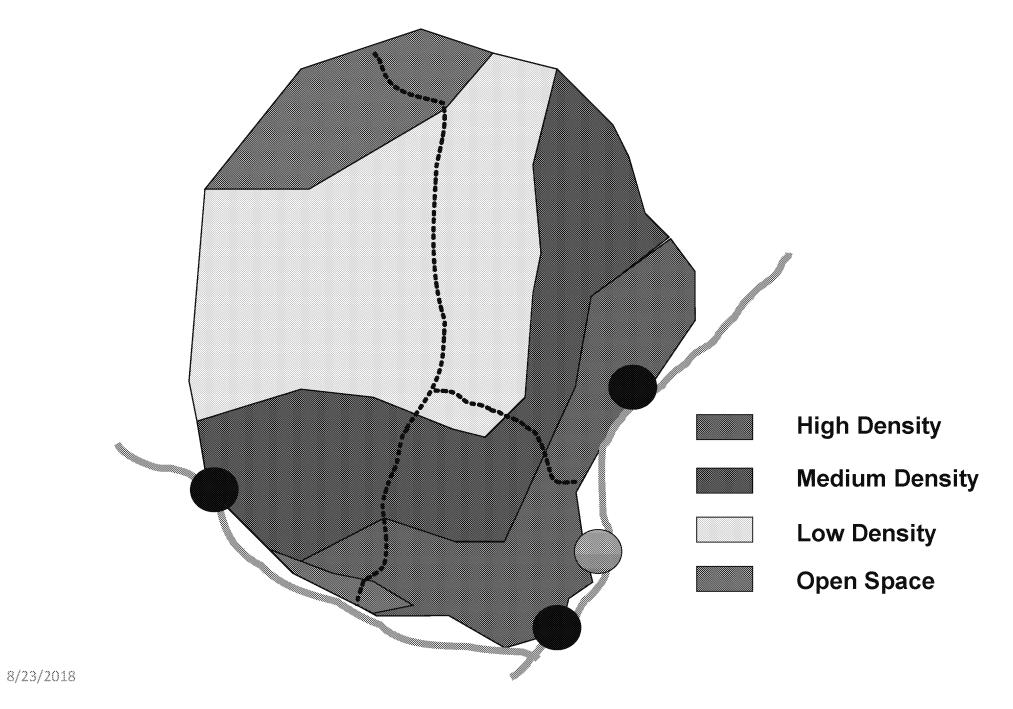
Defining Sub-Sewershed Areas



Characterizing Land Use

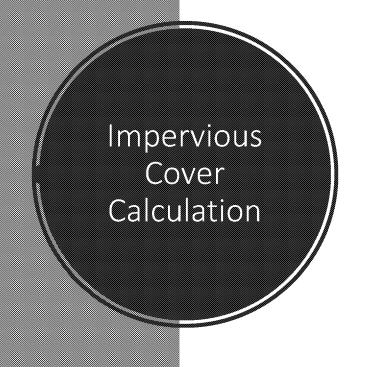
- General land use and estimated impervious cover
 - Some data available from USGS http://edc.usgs.gov/products/landcover/lulc.html#description
- Land use categories include:
 - ➤ Parkland or open space (<5% impervious)
 - Low density development (5-35% impervious)
 - ➤ Medium density development (35-70% impervious)
 - ➤ High density development (>70% impervious)

- The physical characterization is more than pipes and pumps. We need to know what is happening at the surface of the earth because that is where rainfall –produced runoff is generated, and the entry of this runoff into the CSS is what causes CSO problems
- We need to know land use and impervious cover
- Impervious cover is very important because just about all of the rain that falls on impervious cover becomes runoff and enters the CSS



Tabulating Land Use - Example

	Parkland/ Open Space	Low Density Development	Medium Density Development	High Density Development
CSO Area #1	25%	40%	25%	10%
CSO Area #2	10%	25%	45%	20%
CSO Area #3	5%	15%	30%	50%



25% park (3% impervious)	0.8%
40% LDD (25% impervious)	10.0%
25% MDD (50% impervious)	12.5%
10% HDD (75% impervious)	7.5%
Estimate of Impervious Cover:	30.8%

Example: CSO Area #1 includes:

Pipe, Capacity, & Flow Information

- Hydraulic analysis should be sufficient to:
 - Establish capacities for WWTP, pump stations and CSO regulators
 - ➤ Quantify dry weather and wet weather flows, including flows to CSS from neighboring communities
 - ➤ Describe any existing flow metering
 - ✓ Permanent system meters and monitors such as SCADA (Supervisory Control And Data Acquisition)
 - ✓ Metering/flow monitoring from previous studies
 - ➤ Identify problem areas and bottlenecks

Springfield: Pump Station and WWTP Capacities (MGD)

WWTP	Average daily flow rate	4.0
	▶ CSS area	2.5
	Separate sewer area	1.0
	Satellite communities	0.5
	Primary treatment capacity	12.0
	Secondary treatment capacity	6.0
Pump Station	Average daily flow rate	3.0
	Maximum pump rate	6.0

CSO Area #1	Dry weather flow rate	1.0
	Regulator capacity	3.0
CSO Area #2	Dry weather flow rate	0.5
	Regulator capacity	2.0
CSO Area #3	Dry weather flow rate	1.0
	Regulator capacity	2.0

Springfield CSS Capacities (MGD)

Rational Method

```
Q<sub>wet</sub> = CiA;Where:
```

C = Runoff Coefficient (% Imperviousness)

i = Rainfall Intensity

A = Area

- Rainfall intensity "i" is variable
- Not designing the system for a typical or design rainfall event
- Making a determination how the Combined Sewer System (CSS) will react due to a precipitation event

18

Springfield Hydrologic Flow Balance, Q_{wet} = CiA

CSO Area #1 wet weather runoff

(30.8% impervious) x (1" rain) x (300 acres)

= 2.5 MG runoff per inch of precipitation

CSO Area #2 wet weather runoff

(43.8% impervious) x (1" rain) x (250 acres)

= 3.0 MG runoff per inch of precipitation

CSO Area #3 wet weather runoff

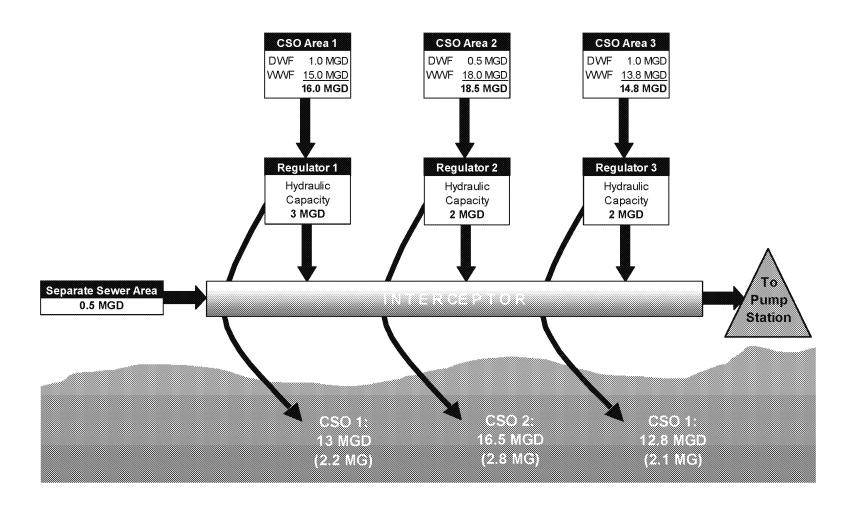
(56.4% impervious) x (1" rain) x (150 acres) = 2.3 MG runoff per inch of precipitation

C = Runoff Coefficient (% Imperviousness)
i = Rainfall Intensity
A = Area

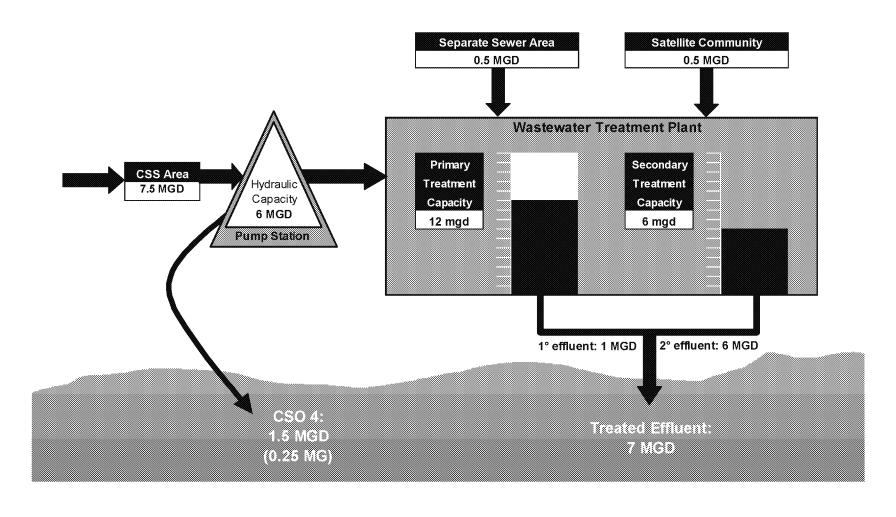
Springfield: Hydrologic Flow Balance, Q_{wet} = CiA

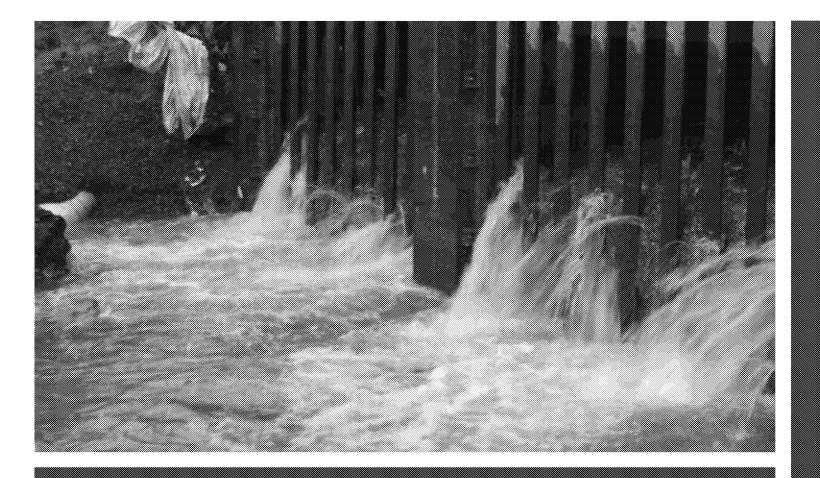
CSO Area #1 wet weather runoff	2.5 MG runoff over 4 hours of rainfall	= 15 MGD average flow rate
CSO Area #2 wet weather runoff	3.0 MG runoff over 4 hours of rainfall	= 18 MGD average flow rate
CSO Area #3 wet weather runoff	2.3 MG runoff over 4 hours of rainfall	= 13.8 MGD average flow rate

Flow Balance Diagram



Flow Balance Diagram

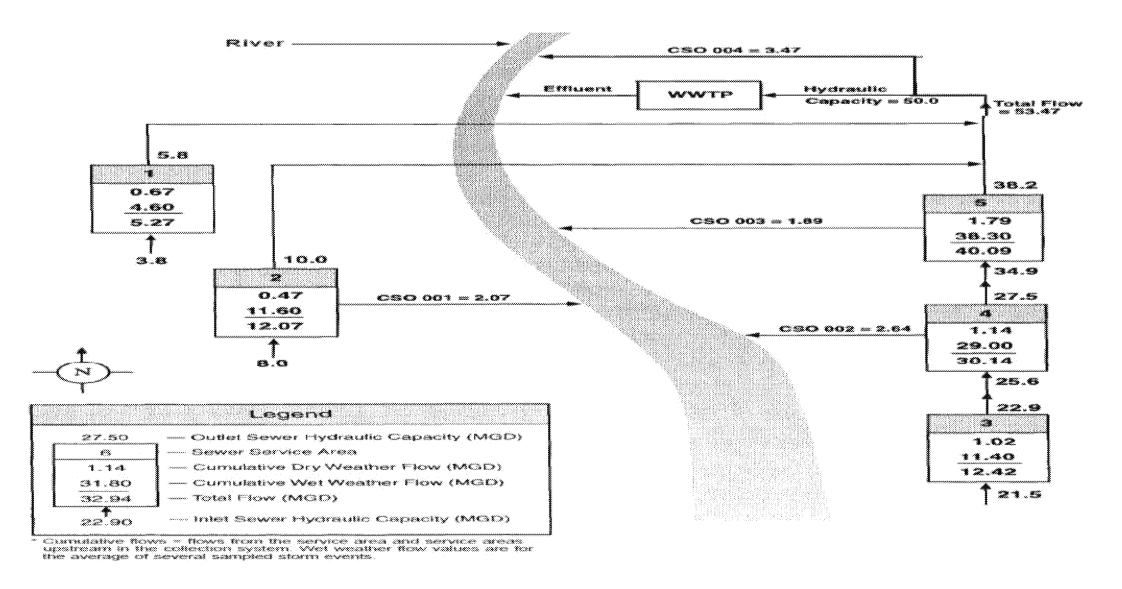


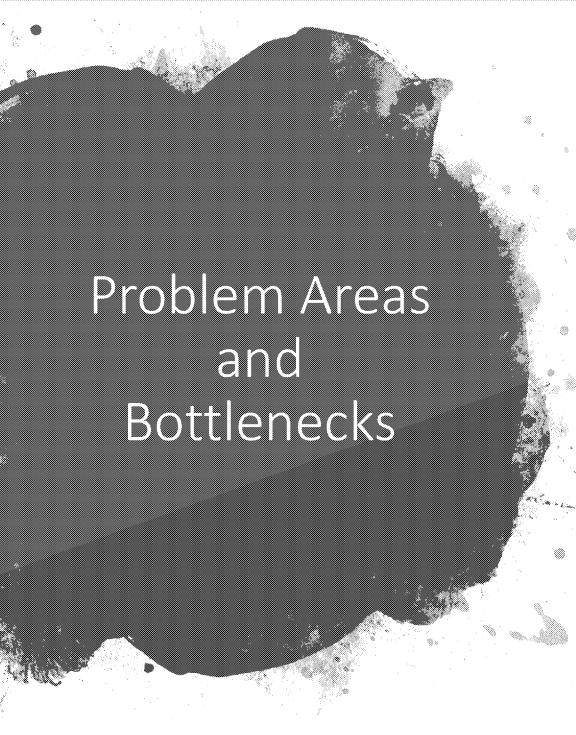


For 1 inch. 4 Hours Rainfall Event

- Total Overflow volume:
 - Pump Station CSO 04 = 0.25 MG
 - >CSO Area 01 = 2.2 MG
 - > CSO Area 02 = 2.8 MG
 - >CSO Area 03 = 2.1 MG
 - > Total = 7.35 MG

Exhibit 3-1. Basic Flow Balance Diagram

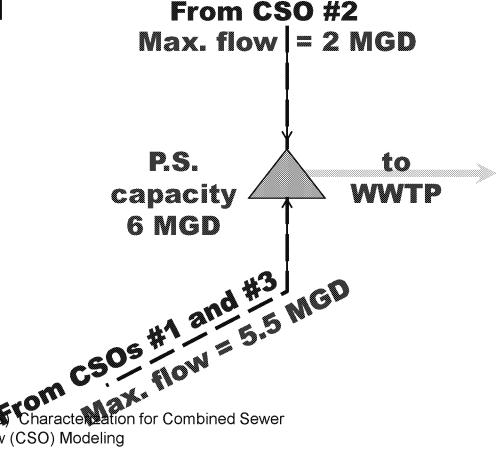




- Compare capacity at key locations in the collection system with peak wet weather flow rates
 - ➤ Intersections of major interceptors
 - **≻**Regulators
 - **≻**Pump stations
 - ➤ Cross connections
- Additional study may be required in areas that often flood during wet weather

Example—Bottleneck

- Pump station capacity should equal or exceed capacity of interceptors delivering flow
- Overflow = 5.5+2-6 = 1.5 MGD



Combined Sewer System (CSS) Overflow (CSO) Modeling



Gravinires mudium

- Storage
 - ➤In-Line
 - ➤ Off-Line
- Pump Station Capacity Increase
- Maximizing Flow to the WWTP
- Increase Secondary Treatment Capacity

Greeningrassicionia

Various Green Practices

Salva Salva in

Springfield CSO controls in-place or in- progress cont.

• CSO 04:

- Increased Hydraulic Capacity of Pump Station = 10 MGD
- Revised Overflow Volume = 0
- CSO Area 01:
 - ➤ Off-Line Storage = 2MG
 - Revised Overflow Volume = 2.2 MG-2.0 MG = 0.2 MG
- CSO Area 02:
 - > Total sewer Separation in progress
 - Revised Overflow Volume = 2.8 MG, No change
- CSO Area 03:
 - Green Infrastructure in place = 0.5 MG
 - Regulator 03 Capacity Increase in progress = 10 MGD
 - Net decrease in overflow volume = 0.5 MG due to GI
 - Revised Overflow Volume = 2.1 MG – 0.5 MG = 1.6 MG

WWTP

- ➤ Adding 2.0 MGD Chemically Enhanced Bio-Actiflow Unit in progress
- ➤ No Blending

Springfield CSOs due to 1 inch. four hour rainfall

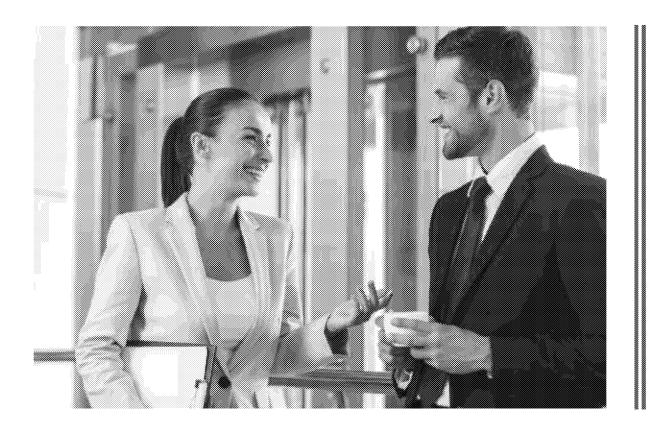
01

Before CSO controls overflow volume = 7.35 MG 02

Total revised overflow volume due to partial controls in-place = CSO 04 + CSO Area 01 + CSO Area 02 + CSO Area 03 = 0.0 MG + 0.2 MG + 2.8 MG + 1.6 MG = 4.6 MG

03

Reduction in CSO
Volume = 7.35 MG = 4.6
MG = 2.75 MG





Conversation





Combined Sewer System (CSS) Characterization for Combined Sewer Overflow (CSO) Modeling

- Based on this concept develop a CSO event and CSO volume modeling tool
 - Excel spreadsheet-based template
 - ➤ Guidance How to use the template
- Similar to LTCP-EZ and Green LTCP-EZ Template